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Sorghum Newsletter

VOL. 1

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SORGHUM RESEARCH COMMITTEE

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SORGHUM NEWSLETTER

Vol. 1

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Sponsored by the Sorghum Research Committee
W. M. Ross, Editor

CONTENTS

		Page
I.	INTRODUCTION	1
II.	CONTRIBUTIONS FROM COOPERATORS	
	Arkansas	2
	California and U.S.D.A.	3
	Georgia	7
	Indiana	11
	Iowa	13
	Kansas and U.S.D.A.	16
	Kentucky	31
	Missouri	31
	Nebraska and U.S.D.A.	32
	North Dakota	35
	Texas	39
	U.S.D.A.	41
III.	PUBLICATIONS	42
IV.	MAILING LIST	49

I. INTRODUCTION

John H. Martin (Beltsville, Maryland)

In 1954 I advised with some economists who had been asked to estimate the probable acre yield of grain sorghum in the United States by the year 1975. The trend, with adjustments for expected future improvements, indicated a maximum average yield of 28 bushels per acre. That yield was attained in 1957, with much help from the weather and from shifts into areas of higher average rainfall. Recently revised estimates of future trends indicated an average yield of 40 bushels per acre by the year 2010 A.D. I will not be around to "take the rap" if that goal is not reached, and it is too late now for me to even make any direct contributions toward its attainment. All I can do is to pass out advice - a very cheap commodity.

An average yield of 40 bushels per acre will require the use of better hybrids than we now have. The hybrids and their parent lines must be resistant to all of the common diseases and insect pests that now damage sorghum. Good weed control and good tillage and planting practices will be essential, and irrigation and fertilizers will add the final step necessary to attain such a high average yield.

The sorghum breeders have the task of improving the lines to be used in hybrid seed production. Each line should resist lodging, charcoal rot, periconia root rot, head smut, five races of kernel smut, rust, three bacterial leaf blights, three or more fungus leaf blights, stalk rots, seed rots, chinch bugs, aphids, corn earworm, sorghum webworm, rice stinkbug and corn borers. These characteristics will need to be incorporated into lines having such desired factors as yield, height, maturity, seed size, seed color, seed texture and head drying. This may involve the transfer of 20 to 50 genes into each parental line.

If these objectives cannot be reached in the next 50 years, my reputation as a prophet will suffer a severe blow in 2010 A.D.

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II. CONTRIBUTIONS FROM COOPERATORS

ARKANSAS

R. L. Thurman (Fayetteville)

Approximately 267,000 acres of sorghum were planted in Arkansas in 1957. Much of the acreage was planted because of the unfavorable climatic conditions for planting of other crops at a normal planting date. An estimated 50 acres were never harvested because it was frosted while green and unfavorable fall weather. It was evident that a high planting rate per acre contributed to small stalks and lodging in many fields. In previous years the average yield per acre for grain sorghum approached that of corn only in dry years. The average yield of corn for 1957 in Arkansas was 26 bushels compared to 24 for grain sorghum. It is somewhat surprising that the 1958 estimate acreage is 227,000 in view of the 1957 crop.

Research Items

1. Sorghum grain was exposed to birds to determine if differences existed among varieties and/or hybrids. Five holes, 2-inches in diameter, were drilled in a 2-foot length of 2 x 4 lumber. The holes were filled with sorghum seed and the boards placed in the loft or top of equipment sheds and barns at the Main Experiment Station farm. It was found that the grain of one experimental hybrid consistently remained undisturbed indicating differences do exist. The supply of grain was exhausted before it was determined whether the difference was due to broken grain, color, etc. (R. L. Thurman)

2. Oats and vetch are being overseeded in grain sorghums which are in the dough stage of maturity. The sorghum may be later harvested with a combine and the overseeded stubble grazed. Work to be continued in 1958. (M. S. Offutt and R. L. Thurman)

3. Efforts will be made to complete the work on factors contributing to quality in forage sorghums in 1958. It is evident that leaf area (sheath and blade) as affected by such factors as planting rate contributes to ensilage quality. The breeding program has been reorganized for 1958 as a result of this work. (R. L. Thurman)

4. A study of some of the insects attacking grain sorghum seed in storage indicated differences existed among varieties and hybrids. A significantly larger number of insects developed in some than in others in stored grain. (L. H. Rolston)

5. Sorghum was grown under irrigation for silage in 1954, 1955, and 1956, and for grain in 1955 and 1956. Irrigation increased the

yields of silage and grain in each year. In 1954, Atlas, Sart and Tracy yielded 21, 28, and 25 tons per acre, respectively, under irrigation. The non-irrigated yields were 6, 5, and 7 tons per acre. In 1956 and 1957 Tracy sorghum, when irrigated, yielded 30 and 27 tons per acre, while the non-irrigated yielded 17 and 19 tons per acre. In 1956, irrigated Wiley sorghum produced 26 tons per acre as compared to non-irrigated yield of 18 tons per acre.

Grain sorghum yields (Plainsman) for 1955 and 1956 were 82 and 69 bu./acre under irrigation and 55 and 48 without irrigation. (D. A. Brown)

The sudan, millet, Johnsongrass and perennial sorghum work has been shifted to Dr. Spooner, who is assigned to a new position in pasture management.

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CALIFORNIA and U.S.D.A.

Brawley, a New Variety of Sweet Sorghum for Southern California

I. E. Stokes (Beltsville, Maryland)

A new variety of sweet sorghum, named Brawley in honor of the city by that name in the Imperial Valley of Southern California, was released for commercial culture by the U. S. Department of Agriculture and the California Agricultural Experiment Station on April 17, 1958. Tests made over a period of three years in different areas of California indicate that Brawley has superior qualities of early maturity, lodging resistance, and a high sugar content. It is adapted to growing conditions in the southern part of the state. Because of its early maturity, Brawley can produce two crops annually from one planting in the Imperial Valley. When two crops are harvested annually, it produces approximately 50 tons of stalks per acre. Leaves and seedheads of the variety comprise approximately 30 percent of the total weight of the stalks. Stalks are mid-juicy; the juice has a high sucrose and a low reducing sugar content.

Brawley originated from a cross that was made by Charles Price, Agronomist, Crops Research Division, Agricultural Research Service. The cross was between a selection from Rex, that had some lodging resistance, and a high-sucrose, lodging-resistant selection from an increase plot of White Seeded Collier. The variety is not immune to red rot, leaf anthracnose, and other sweet sorghum diseases; however, in southern California there has been no damage from these diseases. A special advantage of Brawley is its ability to resist lodging under normal field conditions.

Forage Sorghum Variety Tests at the Imperial Valley Field Station in 1957

George F. Worker, Jr. (El Centro) and Dale G. Smeltzer (Davis)

Forage sorghum varieties have been tested extensively for three years at this station. For the past two years plantings have been made by April 1 as well as in early July. From plantings made on March 1 or April 1 two harvests have been made. The first harvest was made when the plants reached the proper stage of development for making good quality silage - from early July to mid-August depending on variety. Following the first cutting, a heavy application of nitrogenous fertilizer was made, and a second crop was harvested in October or November from regrowth from the original stubble. From 6 varieties in three tests (Table 1) the average yield of the first cutting was 26.4 tons of forage (67% moisture) per acre. For the second harvest the average yield was 17.8 tons making a total of 44.2 tons per acre for the year. In comparison, the corn variety Texas 30, which could be harvested only once from each planting, gave a yield of 19.3 tons of forage per acre. From plantings made in early July with only one harvest the average yield for the same sorghum varieties was 22.5 tons per acre and for Texas 30 corn 12.5 tons.

As to individual variety performance, Brawley and Rex were the best. Brawley (formerly designated as C-041) is a variety developed by Charles Price, a U.S. Department of Agriculture Plant Breeder. It is a selection from the progeny of a cross between a selection from Rex and a selection from white-seeded Collier. It was released this month by the U.S.D.A. and the California Agricultural Experiment Station, and the seed will be increased to provide an adequate supply for future planting. The forage of Brawley is high in sugar and the plants have shown lodging resistance. Sart has produced high yields, but has coarse stalks and is susceptible to lodging. Atlas and Waxy Atlas are resistant to lodging but are lower in yield, especially from the early plantings. Hegari stands well, but yields have been low. Tracy is later maturing than the other varieties and has produced very little forage for the second harvest after early planting. Other varieties tested such as Honey, Collier, Orange and Sumac have lodged badly.

It appears that forage sorghums could be used profitably for production of ensilage or for green chopping in connection with feed-lot operations.

Eight forage sorghum varieties were compared in replicated trials. Six of the varieties were planted on three dates - March 1, April 1, July 1 - and two were planted on only the last two dates. Texas 30, a hybrid corn variety was included in each test. From the two early plantings two harvests of forage were made from each sorghum variety, but only one for the July planting. For the corn only one harvest was made from each planting. Each variety was harvested when it had reached a stage for good quality silage. The results are summarized in Table 2.

Table 1. Summary of forage yields (67% moisture) of six sorghum varieties grown from various planting dates - Imperial Valley Field Station 1956-57.

Date Planted:	March 30, 1956			March 1, 1957			April 1, 1957			2 Yr. Av.			July 10, 1956	July 1, 1957	2 Yr. Av.
Cutting:	1	2	Total	1	2	Total	1	2	Total	1	2	Total			
Variety															
Brawley	32.4	22.4	54.8	38.3	14.2	52.5	26.3	11.9	38.2	32.3	16.2	48.5	19.0	21.4	20.2
Rex	31.1	15.2	46.3	34.2	18.6	52.8	24.2	17.1	41.3	29.8	17.0	46.8	23.4	24.6	24.0
Sart	28.7	22.4	51.1	18.6	39.9	58.5	27.1	29.0	56.1	24.8	30.4	55.2	27.1	33.8	30.5
Tracy	38.7	9.8	48.5	27.9	8.4	36.3	32.2	5.2	37.4	32.9	7.8	40.7	19.9	25.1	22.5
Atlas	22.2	18.9	41.1	23.6	13.2	36.8	23.0	16.5	39.5	22.9	16.2	39.1	19.3	21.2	20.3
Hegari	18.3	22.7	41.0	11.6	20.0	31.6	17.9	14.9	32.8	15.9	19.2	35.1	17.5	17.7	17.6
Av.	28.6	18.6	47.1	25.7	19.1	44.8	25.1	15.8	40.9	26.4	17.8	44.2	21.0	24.0	22.5

In all tests more forage was obtained from the sorghums than from the corn. The average total production from the March 1 planting was higher than from the April 1 planting, largely because of lower yields from the second cutting. From the two early plantings, the average total yield from the sorghums was 19.8 tons higher than for the July planting. This is in agreement with results obtained in 1956 as shown in Table 1. Thus it would seem that early plantings have definite merit for total seasonal production.

Table 2. Yield and other agronomic data from forage sorghum tests at the Imperial Valley Field Station in 1957.

	Date Planted	Height Inches		Lodging %		Date Harvested		Yield		Total[1] Yield
Cutting:		1	2	1	2	1	2	1	2	
Variety										
Sart	3-1	82	71	0	64	7-3	11-10	18.6	39.9	58.5
	4-1	96	87	10	4	7-29	11-12	27.1	29.0	56.1
	7-1	110	--	9	--	11-12	---	33.8	--	33.8
Rex	3-1	103	78	0	15	7-29	11-10	34.2	18.6	52.8
	4-1	104	76	15	1	8-7	11-12	24.2	17.1	41.3
	7-1	99	--	0	--	11-12	---	24.6	--	24.6
Brawley (C-041)	3-1	108	71	0	3	7-29	11-10	38.3	14.2	52.5
	4-1	105	73	33	1	8-7	11-12	26.3	11.9	38.2
	7-1	86	--	0	--	11-12	---	21.4	--	21.4
Atlas	3-1	80	78	0	0	7-18	10-17	23.6	13.2	36.8
	4-1	84	81	0	0	7-29	11-12	23.0	16.5	39.5
	7-1	84	--	0	--	11-12	---	21.2	--	21.2
Tracy	3-1	98	63	1	0	8-7	11-10	27.9	8.4	36.3
	4-1	103	56	0	0	8-16	11-12	32.3	5.2	37.5
	7-1	85	--	0	--	11-12	---	25.1	--	25.1
Hegari	3-1	54	49	0	0	7-3	10-1	11.6	20.0	31.6
	4-1	52	59	0	0	7-18	10-17	17.9	14.9	32.8
	7-1	58	--	0	--	10-21	---	17.7	--	17.7
Honey Cane	4-1	88	106	0	65	7-18	11-12	26.6	30.9	57.5
	7-1	113	--	68	--	11-12	---	31.0	--	31.0
Waxy Atlas	4-1	73	76	0	T	7-29	11-12	24.9	19.3	44.2
	7-1	85	--	0	--	11-12	---	24.4	--	24.4
Texas 30	3-1	103	--	0	--	7-11	--	20.6	--	20.6
	4-1	86	--	0	--	7-18	--	17.4	--	17.4
	7-1	64	--	0	--	10-2	--	8.3	--	8.3
L.S.D.(5%)	3-1							4.59	4.74	5.49
	4-1							3.75	3.57	5.79
	7-1							5.64	--	5.64

[1] Yield calculated at 67.7% moisture. Average of four replications. Fertilizer: 80 pounds P_2O_5 and 160 pounds Nitrogen per acre broadcast, pre-plant. 100 pounds Nitrogen per acre broadcast after first cutting.

GEORGIA

A. R. Brown (Athens)

Grain sorghum acreage continues to increase in Georgia due to several reasons. Three of these reasons are (1) crop acreage allotments, (2) increased need of local grown feed for a large poultry industry, (3) increased interest in hybrid grain sorghum. There were approximately 40,000 acres of grain sorghum planted in Georgia in 1957. Grain sorghum cannot compete with corn in Georgia as a full season crop but does produce better than corn when planted after small grains as a short season crop.

At present three varieties and three hybrids are being recommended to the farmers of Georgia. These are as follows; Martin, Redbine-66, Redlan, RS 610, RS 650, and Texas 660. These six have been the best yielding selections during the past three years. The Texas hybrids are not too well adapted in the Southeast but are considered as good or better than any hybrids tested thus far. Several hybrids developed for Georgia conditions are looking good and probably will be released shortly.

Several red-seeded male-steriles (Martin, Wheatland, Redlan, Red Combine Kafir 54-13, and W. Blackhull x Day) are being developed and will be used in making hybrids in the future.

Several yellow endosperm selections are showing promise as good yielders and will be tested in replicated yield trials in 1958.

Effects of Row Spacings and Seeding Rates on Yield of Grain Sorghum

H. B. Harris and B. J. Johnson (Experiment)

For many years a limited acreage of grain sorghum has been grown in Georgia; however, the potential of the crop was not recognized until about 1954. The demand for feed grain had increased with the expanded poultry and livestock industries, and commercial feed mixers began using sorghum seed in their products. This provided a commercial market for the crop which had not previously existed.

Interest was further stimulated by the need for a short-season crop to follow small grain, temporary winter pasture crops, or winter legumes harvested for seed. Grain sorghum appeared to be a suitable crop for this purpose.

Agronomic research data for Georgia were lacking, and recommendations were based on field observations or on experimental data collected in areas where insect, disease, and moisture problems were quite different from those in Georgia.

Because of the lack of data upon which accurate recommendations could be based, an experiment was initiated in 1954 at the Georgia Experiment Station to study the effects of various seeding rates and row spacings on the yield of grain sorghum.

The experiment was a split plot with row spacings as the main plots and seeding rates as sub-plots. In the 1954 test, row spacings of 12, 24, and 36 inches were used. These spacings were changed to 24, 32, and 40 inches in the 1955 and 1956 tests, since cultivation of the 12-inch spacing was impractical with available equipment. Seeding rates of 3.3, 6.7, and 9.6 seeds per linear foot of row were used in each row spacing. The 3.3 rate would require about 2 pounds of seed to plant an acre in 36-inch rows. These tests were planted to Redbine-60.

Seed of Martin, E 65 (Comb. Kafir-60 x D. D. Early Shallu), and E 70 (Comb. Kafir-60 x D. Milo Yellow Maize) were planted in 40-inch rows at rates of 4, 8, 12, and 16 pounds per acre in the 1957 test.

As a result of drought conditions following planting, the 1956 test failed to emerge to sufficient stand to warrant harvesting.

Significant yield differences were not evident in the 1954 test (Table 1) at the 5% level. At the low seeding rate the reduction in yield approached the point of significance. The interaction between seeding rate and row spacing also was not significant.

Table 1. The effect of row width and seeding rate on yield of grain sorghum - 1954.

Seed Per Foot of Row	Row Width in Inches			Mean
	36	24	12	
No.	bu.	bu.	bu.	bu.
3.2	34.0	38.3	39.8	37.4
6.4	34.2	43.5	39.6	39.1
9.6	37.7	43.5	36.9	39.4
Mean	35.3	41.8	38.8	
C.V. = 16.76%				

Yield differences due to row spacings were not significant (5% level) in the 1955 test (Table 2). Grain yield was significantly (5% level) reduced at the low seeding rate, and this was evident at all row spacings. The interaction between seeding rates and row spacings was not significant.

Table 2. The effect of row width and seeding rate on yield of grain sorghum - 1955.

Seed Per Foot of Row	Row Width in Inches			Mean
	30	24	12	
No.	bu.	bu.	bu.	bu.
3.2	19.5	20.5	21.7	20.6
6.4	24.8	32.5	28.5	28.6
9.6	31.1	32.5	27.8	30.5
Mean	25.1	28.5	26.0	
L.S.D. .05				7.8
C.V. =34.41%				

Damage caused by birds eliminated Martin and E 70 from the 1957 test. E 65, a brown-seeded hybrid, was not seriously damaged and was, therefore, harvested (Table 3). The 8-pound per acre seeding rate produced significantly greater yields than the 4-pound rate. Rates above 8 pounds were not effective in increasing yields. Whether the need of 8 pounds of seed per acre, which was evident in this test, was due to a seasonal or varietal effect was not determined. This phase will be pursued further.

Table 3. The effect of seeding rate on yield of grain sorghum - 1957.

Seeding Rate per Acre	Yield per Acre
lbs.	bu.
4	44.5
8	54.9
12	60.8
16	59.9
Mean	55.0
L.S.D. .05	8.3
C.V. = 9.0%	

In summary, there were no significant yield differences between row spacings of 12 to 40 inches. Significant yield differences were not evident in the 1954 test for seeding rates; however, in the 1955 test 6.4 seed per linear foot of row (4 lbs. of seed per acre in 36-inch rows)

produced significantly greater yields than the 3.2 seed per foot rate. Heavier rates neither reduced nor increased yields significantly. Eight pounds of seed per acre produced significantly greater yields than the 4 pound rate in the 1957 test.

Heterosis in F_1 Hybrids of Sorghum x Sudangrass

J. P. Craigmiles, H. B. Harris, J. P. Newton (Experiment)
J. W. Dobson (Blairsville)

Sudangrass (*Sorghum sudanense* (Piper) Stapf.) and grain or forage sorghum (*Sorghum vulgare*) Pers. each have the same number of chromosomes and cross readily with each other. Although this cross has been reported by several workers, no report has been found of the forage performance of the F_1 hybrids between these two species.

This note reports the forage performance of the F_1 hybrid, sorghum x sudangrass.

In 1956, crosses were made between male-sterile Combine Kafir-60 x Tift sudangrass and male sterile Combine Kafir-60 x Rhodesian sudangrass (*S. arundinaceum*) by planting in alternate rows. F_1 hybrid seed from these crosses was planted in a randomized block design at three locations in Georgia and forage yield taken of the hybrids, their sudangrass parents, and 4 hybrid forage sorghums (NK 3055, NK 3065, DeKalb 1-49-93, and S-210). The average yield of the forage sorghums was used in preference to the kafir parent since the kafir is a grain type that produces very little forage and no regrowth after clipping. Three clippings were made for dry matter determinations, and the leaf-stem ratios were computed as a measurement of quality.

Results of these tests are summarized below. The F_1 hybrids averaged 29.1% more dry forage than the average of the sudan parents and forage sorghums. This increase may be attributable to heterosis. Compared to the leafier sudangrass parents the hybrids had 11% fewer leaves, which suggests a lower quality forage. The F_1 hybrid is similar to sudangrass in appearance although it has broader leaves and thicker stems. It possesses an open panicle-type head with seed of the same shape, size, and appearance as the grain sorghum parent.

Comparison of the forage production of sorghums, sudangrass, and the F_1 hybrid, sorghum x sudangrass

Species	Pounds dry matter per acre Av. 3 locations
Tift sudangrass	8185
Rhodesian sudangrass	8414
Forage sorghum	8340
Tift x sorghum (F_1)	10903
Rhodesian x sorghum (F_1)	10565
L.S.D. (5%)	616

Development of a Male-Sterile Sudangrass

J. P. Craigmiles and J. P. Newton

Sudangrass improvement has been directed toward the development of highly productive disease resistant varieties. These varieties have possessed such characters as high sugar content, low prussic acid potential, high leaf-stem ratio, good recovery after clipping, and desirable maturity date. To obtain these desired characteristics the methods of breeding have followed a fairly set pattern. This consists of making a cross between parents possessing the desired characters and then reselecting and stabilizing these factors. This has been accomplished through individual plant, plant-to-row, and mass selections, the final product being a fairly stable, open-pollinated variety or synthetic.

As in most plant species the most desirable way to increase production and to stabilize the desired characteristics is through the utilization of heterosis in F_1 hybrids. In sudangrass breeding this has been unsuccessful because of the lack of a good source of male-sterility. The cytoplasmic male-sterility used in hybrid grain sorghum has not been successfully transferred to commercial varieties of sudangrass. The procedure was unsuccessful because of the presence of fertility restoring factors in these varieties.

By a series of backcrosses the cytoplasmic male-sterility has been successfully transferred to Rhodesian sudangrass, (*Sorghum arundinaceum*-P. I. 156549). This introduction from Rhodesia is a vigorous plant with considerable disease resistance, although the seeds shatter badly. It is presently in the fifth backcross generation, and the sterility has maintained itself perfectly. F_1 hybrids have been obtained between male-sterile Rhodesian x Tift and male-sterile Rhodesian x Piper. These hybrids appeared outstanding in leafiness and forage production in an observational test during the summer of 1957. They will be tested in clipping studies during the summer of 1958, and if the performance warrants, seed will be made available through Dr. A. A. Hanson, Forage and Range Section, Crops Research Division, U.S.D.A., Beltsville, Maryland.

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INDIANA

R. C. Pickett (Lafayette)

John Clark from Washington State University began graduate school in September 1957 and is engaged in a thesis problem comparing the hybrid vigor of synthetics with single cross hybrids of various types in sudangrass.

Morris Bitzer, a senior student, worked a special problem in 1957 on the proportion of head, leaf, and stem along with other notes on various experimental hybrid forage lines.

Wayne Whitehead will assume charge of the sorghum testing program in Indiana on or about July 1, 1958. Grain sorghum, forage sorghum, and sudangrass are all part of this program with test locations on the Sand Experiment Field in northern Indiana, at Lafayette, and on the Southern Indiana Forage Farm.

A breeding program is underway on all three groups of sorghum (since 1956) under the direction of R. C. Pickett at Lafayette.

T. G. Garrison took the basic data for an M.S. thesis in 1957 on the interaction of row spacing, seeding rate, and fertility (mainly N) on two varieties of grain sorghum and forage sorghum at three locations.

Neal Barnett, a senior student, is running a special problem in the greenhouse on sorghum flooding. Grain sorghum has survived flooding completely over the tops for as long as four weeks. Comparatively little damage resulted from two weeks under water. Removal of bloom speeded up damage from both flood and drouth. Corn plants under similar conditions died in 4 to 6 days.

Shallow flooding (two inches over soil surface) resulted in relatively little damage with the sorghum continuing to head and flowering stage. Some lower leaves were lost. Many "water roots" were formed on top of the pots.

There is preliminary evidence of differences among genotypes of sorghum in ability to withstand flooding.

General observations of interest:

All of the sorghum in southern Indiana tests is being grown in close non-cultivated rows. Row spacings of 7 or 14 inches seem more productive than 21 inches, but even the latter have maintained satisfactory weed control and good production.

Nitrogen fertilizations of 100#/acre or more beyond normal minimum amounts have increased yield but also promoted earlier heading, flowering, and seed ripening by as much as a week or 10 days at three locations in 1957.

When moisture conditions were favorable, as in 1957, populations of 120,000 plants per acre or more yielded most with little decrease up to 240,000 plants per acre.

We have a paper on sorghum sterility in press:

Maunder, A. B. and R. C. Pickett. The genetic inheritance of cytoplasmic-genetic male sterility in grain sorghum. Agronomy Journal.

A single nuclear gene (ms_c - suggested designation) interacted with sterile cytoplasm to produce male sterility in 27 stocks.

An M.S. thesis on sudangrass was completed in January 1958. Sotomayor-Rios, Antonio. Cross pollination and hybrid vigor in sudangrass.

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IOWA

Grain Sorghum Research and Testing

R. E. Atkins (Ames)

The sorghum project at the Iowa Station was reorganized in 1957 with responsibility for the forage sorghum and sudangrass work assumed by R. R. Kalton and the grain sorghum program by R. E. Atkins. Yield tests of grain sorghum hybrids and varieties were conducted at six locations in 1957, primarily in southern and western sections of the state, and results published in Agronomy Leaflet 422. Tests will be continued at these locations in 1958, but have been organized as a cooperative program between the Iowa Crop Improvement Association and the Iowa Agricultural Experiment Station. Organization is similar to that employed in conducting the state corn yield test with a fee of $20.00 per entry per location charged for entries by commercial hybrid companies. A total of 127 entries were made for the 1958 tests by seven companies.

Planting date studies in 1957 at Ames resulted in essentially equal yields for hybrids and varieties planted at weekly intervals from May 22 through June 12. A slight yield reduction occurred when plantings were delayed until June 19, and a marked reduction in yield was observed for the plantings made on June 26. Average moisture content of six entries in the test at the time of first killing frost (October 11) was increased about 3 percent for each of the first four weekly delays in planting and 8 and 7 percent for the last two weekly delays, respectively.

Plant population studies at Ames in 1957 showed maximum yields for populations of 5 plants per foot in 40-inch rows. Stands of 3, 4 and 6 plants per foot were only slightly lower, however, indicating a fairly good range in plant populations may result in essentially equal grain yield. As very little response was obtained from 40 and 80 pound per acre applications of nitrogen in these studies meaningful information on plant population x fertility level interactions was not obtained for the 3 varieties and 3 hybrids in the test. Mr. Abdulla El Kadi was conducting these studies as a PhD thesis problem. Due to his untimely death in an automobile accident this winter, these studies will be continued in much less detail in 1958. A study of grain sorghum production in rows spaced 12, 18, 24, 30, 36, 42, and 48 inches apart with intra-row plant

spacings of 2, 4, 6, and 8 inches was initiated in 1957 in cooperation with Mr. Ben Grover at the Kanawha branch station. Maximum yields were obtained in rows 6 inches apart with plants at 2-inch intervals. Results were quite variable, however, and it is planned to obtain additional information in 1958 on this experiment.

Selective herbicides were compared on plots of RS 610 at Ames in 1957 in cooperation with Dr. D. W. Staniforth of the Botany Department. Randox at 4 lb./acre as a pre-emergence spray was most effective in controlling weeds and did not reduce stands of the sorghum. The 2.5 lb./acre rate of Simazin and 2,4-D ester at 1 lb./acre also controlled weeds fairly effectively as pre- emergence sprays, but slightly reduced stands of sorghum. Simazin at 5 lb./acre and 2,4-D ester at 2 lb./acre markedly reduced stands of the sorghum.

Preliminary evaluations for resistance to second brood corn borer of 35 grain sorghum hybrids and varieties were made in 1957 in cooperation with Dr. F. F. Dicke of the Regional Corn Borer Research Laboratory, Ankeny, Iowa. Plants were infested from shortly before head emergence to active pollen shedding. Sheath lesions, peduncle cavities and larvae per plant increased progressively as infestation was originated later during head emergence reaching a peak at the active pollen shedding stage. In general, the later maturing varieties and hybrids were most susceptible and early maturing types least susceptible. Results must be considered only preliminary in nature, however, and it is planned to expand and modify these studies considerably in 1958.

Other studies at Ames in 1957 included a study of effects of artifically drying grain at 4 different drying temperatures for samples harvested at varying grain moisture content over a six-week period from September 20 to October 31. Eight harvests each were made from RS 501 and Tx 620 hybrids and from the Combine Kafir-60 (ms) rows of a seed production field of RS 501. Seedling emergence, seedling vigor and kernel weight data are being summarized from these samples but are not yet completed.

Additional studies planned for 1958 will include an examination of rate of moisture loss from the grain and several plant parts of different grain sorghum types as they approach maturity. This will be conducted by Mr. Ivan Wikner as an M.S. degree thesis and will include a number of types of varying head compaction. Effects of several freezing temperatures on grain sorghum of varying moisture content in relation to seed viability will be evaluated by Mr. Gerald Carlson as an M.S. degree thesis problem. Breeding studies were initiated on a limited scale in 1957, with at least a partial purpose of enabling the writer to learn something of the problems of sorghum breeding after gaining most of my previous experience with small grains. Perhaps I'll be able to get in "deeper water" during the coming season.

Forage Sorghum Tests in Iowa in 1957

R. R. Kalton (Ames)

Six varieties and eight hybrids of forage sorghum were compared with a grain sorghum and corn hybrid at two locations in Iowa in 1957. A brief summary of results for certain hybrids of interest appears in Table 1. The greatest manifestations of hybrid vigor occurred with RS 301F and RS 302F. The latter has been highly susceptible to lodging in two years of testing at Ames. The Axtell and Atlas hybrids have not shown any clear-cut superiority to their male parents. A complete summary of these tests is available as Agron. 433. Mimeo. March, 1958, from the Agronomy Dept., Iowa State College, Ames, Iowa .

In two early planted (mid-May) observation plots the DeKalb hybrid, FS1, showed a marked superiority in stand establishment under adverse conditions. RS 301F was fair and Atlas poor to fair in germination and seedling vigor in these plantings. Results in 1956 were similar. Differences in seedling vigor and germination under adverse conditions appear highly worthy of breeding exploitation if evaluation techniques can be established.

Table 1. Agronomic performance of several forage sorghums and their hybrids with Combine Kafir-60 ms at two locations in Iowa in 1957.

		Ames		Albia	
	Date of bloom	Lodging (%)	Tons/acre dry weight	Lodging (%)	Tons/acre dry weight
Rox Orange	8-15	2	5.09	6	4.81
RS 301F	8-14	14	6.40*	0	6.66
Leoti Red	8-14	54	5.74	15	5.13
RS 302F	8-12	65	7.22	3	6.29
Axtell	8-15	20	6.60	0	5.23
RS 303F	8-14	3	5.70*	0	4.91
Atlas	8-21	50	5.65	0	6.28
CK 60 ms x Atlas	8-15	58	6.18*	0	5.31
RS 610 (grain)	8-9	0	3.24	0	3.14
Corn	8-6	-	5.29	-	5.12

*Heads bagged to prevent seed set.

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KANSAS and U.S.D.A.

Sorghum Breeding and Genetic Work at Manhattan, Kansas, 1957

A. J. Casady (Manhattan)

Continued breeding for resistance to covered kernel smut over the past 20 years has resulted in several acceptable resistant combine-height grain sorghum selections. Forty-seven final selections were made in 1957. Inoculation with a composite of the five physiologic races of covered kernel smut has shown these selections to be as resistant as Spur Feterita, the original source of resistance. All selections will be tested for possible use in hybrids. Some preliminary work has indicated that both sterile and restorer lines are available. Listed below are the pedigrees of this resistant material and the number of selections available from each cross:

Pedigree	No. of selections
Westland x Spur-Blackhull^3	6
Spur-Blackhull^3 x Dwarf Kafir 44-14	7
Midland x Spur-Blackhull^3	12
Spur-Blackhull^3 x Redbine-60	17
Spur-Blackhull^3 x Martin	5

An inheritance study of resistance to physiologic races 1, 2 and 3 of covered kernel smut was made, using Spur Feterita as the resistant parent and Pink Kafir as the susceptible parent. Two hundred and seventeen F_3 lines of the cross Spur Feterita x Pink Kafir were used for this study. The results of this study are reported in the accompanying table. An attempt was made to determine the dominance or recessiveness of resistance by use of an F_1 population, but the incidence of smut infection was so low, as evidenced by the rate of infection in the susceptible parent, that no definite conclusion could be made. However, it appeared that resistance was at least partially dominant in the case of physiologic races 1, 2, and 3.

Covered kernel smut data from F_3 progeny of the cross, Spur Feterita x Pink Kafir and the susceptible parent Pink Kafir, inoculated with physiologic races 1, 2, and 3 and grown in the field and greenhouse. Manhattan, Kansas. 1957.

Physiologic Race	Total 1/ Lines or Plants	Smut Data Smutted	Smut Data Unsmutted	Chi-2/ Square	P-Value	% Infection
		F_3 Progeny of Spur x Pink Kafir 3/				
1	217	154	63	1.88	.10-.20	
2	217	166	51	0.25	.80-.90	
3	217	162	55	0.01	.98	
		Susceptible Parent, Pink Kafir 4/				
1	80	60	20			75.0
2	74	49	25			66.2
3	75	50	25			66.7

1/ Lines in case of F_3 progeny; plants in case of Pink Kafir.
2/ Assuming a 3:1 ratio.
3/ Combined greenhouse and field data..
4/ Field data only.

Notes on Combine Kafir-60 x Sudangrass Forage Hybrids

H. L. Hackerott and W. M. Ross (Hays)

At least one major commercial producer of hybrid sorghum seed has shown interest (almost to the point of production) in forage hybrids using combine grain sorghum females and sudangrass males. The results obtained with such crosses at the Fort Hays station should be noted.

A yield trial was planted in 1957 consisting of 9 Combine Kafir-60 x sudangrass hybrids, 2 sudangrass varieties, 2 forage sorghum hybrids, and 2 forage sorghum varieties. The kafir-sudan hybrids appeared promising and looked unusually productive. However, a two-inch rain fell in August, accompanied by high winds, and the sudangrass hybrids lodged almost completely. Some regained erectness partially but most did not, and only the two most erect hybrids were harvested. The forage sorghums and sudangrass varieties lodged considerably less. Yield data appear in table 1.

In general, the sudangrass hybrids appear to have no advantage. They do not yield as well as good forage sorghum varieties, and they lodge much more. They cannot be used for pasture in northern areas as

it is assumed they are high in prussic acid as most sorghum-sudangrass hybrids are. After harvest it was noted that the recovery of the hybrid stubble was intermediate between sudangrass and forage sorghum.

Table 1. Comparisons of sudangrass hybrids and checks, Hays, Kansas, 1957.

	Date bloom	Yield*
		tons/acre
Combine Kafir-60 x Piper	8-5	7.07
Combine Kafir-60 x Tift	8-8	7.97
Greenleaf	8-15	5.79
Wheeler	7-18	4.17
RS 301F	8-8	7.65
Atlas	8-16	9.39
L.S.D. 0.05		1.12

* Silage yields, 30% dry matter.

Evidence for Bifactor Inheritance of Cytoplasmic Male-sterility

W. M. Ross

Early in the hybrid sorghum work it became apparent that wide crosses best expressed heterosis. In 1955 F_2 segregates of Day milo (Day ms) x Double Dwarf White Feterita were crossed onto Combine Kafir-60 ms (cytoplasmic) for purposes of early testing. Surprisingly, in 1956, 12 of the test crosses were sterile or nearly so, 37 were segregating, and 29 were fertile or nearly fertile. Taking into account the Day male-sterile gene, the results could be explained only by the assumption of a second nuclear factor dominant for male-sterility.

The expressions of sterility and fertility were assumed as follows: A_B_, A_bb, and aabb-fertile; aaBb-intermediate; and aaBB-sterile. The genotypes of the lines involved then become:

Combine Kafir-60 ms	aaBB
Day ms	a'a'BB
Day	AABB
D. D. W. Feterita	AAbb

Backcrosses were grown in 1957 to test the hypothesis to explain the 1956 results. The 1957 data appear in table 1.

In the first two crosses there was a fairly even distribution of from 5 to 95 percent fertility in the intermediate class. In the third cross, when normal Day was used, 18 plants were classified as intermediate, but most of them were grouped at the higher and lower ranges. It seems that the accurate backcross ratio in this case is 1:0:1 while the others are 2:1:1.

From previous studies it has been shown that Day male-sterile is epistatic to fertile Combine Kafir-60. When Combine Kafir-60 male-sterile is used, the Day sterile gene is genetically indistinguishable from it. Stephens and co-workers have ruled out cytoplasmic inheritance in the case of Day male-sterile.

The results from the test cross progenies in 1956 tentatively are explained in table 2 and fit a 6:7:2 ratio as found in table 3. Test cross progenies, which were segregating for fertile and intermediate, were probably classified as fertile because of the lack of good complete sterility. Similarly, progenies that were segregating for sterility and intermediates were classed as sterile because of the lack of good complete fertiles. The intermediate class (aabb) did not lend itself to accurate placement, and because of a range of partial sterility to partial fertility mistakenly was classified as segregating. The F_2 plants in 1955 having the constitution aabb shed sufficient pollen to be used as male parents. Under different environmental conditions, these plants might be classed either as fertile or sterile.

Further studies will be made to check the results obtained. Naming or numbering the dominant gene involved herein is not proposed at this time and will be contingent upon verification of results and upon other inheritance studies of cytoplasmic male-sterility that are concerned with the more common recessive gene.

The results of this study suggest searching for additional factors determining cytoplasmic male-sterility and its restoration in other sorghum groups, such as durra, hegari, shallu, and kaoliang.

Table 1. Backcross ratios testing male-sterility inheritance.

	Fertile (100-95%)	Intermediate (95-5%)	Sterile (5-0%)
	No.	No.	No.
1) Combine Kafir-60 ms x Day ms-D.D.W. Feterita, F_1)	72	35	35
2) Combine Kafir-60 ms x (C.K.-60 ms-D.D.W. Feterita, F_1)	81	43	48
3) Combine Kafir-60 ms x (C.K.-60 ms-Day, F_1)	78	(18)*	66

*Grouped near ends of ranges, probably should be classified 85:0:77.

Table 2. Day ms x D. D. W. Feterita segregates and test cross progeny classification.

F_2 segregates	F_2 reaction	F_3 test cross progeny (when crossed with aaBB)	Clas-sification
1 AABB	fertile	fertile	fertile
2 AABb	fertile	fertile	fertile
2 AaBB	fertile	1 fertile, 1 sterile	segregating
4 AaBb	fertile	2 fertile, 1 intermediate, 1 sterile	segregating
1 AAbb	fertile	fertile	fertile
2 Aabb	fertile	/ fertile, 1 intermediate	fertile
1 aaBB	sterile	--	--
2 aaBb	intermediate	1 sterile; 1 intermediate	sterile
1 aabb	fertile	intermediate	segregating

Table 3. Classification of F_3 test cross progeny, Combine Kafir-60 ms x (Day ms-D. D. W. Feterita, F_2).

Ratio	Found	Theoretical
	No.	No.
6 fertile	29	31.2
7 segregating	37	36.4
2 sterile	12	10.4
Total	78	78.0

Seed Treatment Studies

E. D. Hansing (Manhattan)

Experiments in 1957 with 10 sorghum varieties and hybrids showed emergence results of 49% for untreated seed, 80% for nonmercurial fungicides, and 86% for nonmercurial fungicide-insecticide combinations.

This large increase from 49% to 80% was due to control of disease, while that from 80% to 86% was due to control of insects. Experiments conducted on farms in Kansas in cooperation with county agents have given similar results.

Nonmercurial fungicides have been more effective for sorghum, and since the cost of treating per acre is relatively low they are recommended over mercurial fungicides.

The seed treatments recommended are:

Nonmercurial fungicides

Captan group: Captan 75, Orthocide 75, Captan Dieldrin 75-3
Thiram group: Arasan 75, Panoram 75, Arasan SF-M

Nonmercurial fungicide-insecticides

Captan Dieldrin group: Captan Dieldrin 60-15, Orthocide Dieldrin 60-15
Thiram Dieldrin group: Delsan A-D, Panoram D-31

Mercurial fungicides

Panogen 15, Panogen 42, Ceresan 75, Ceresan 100, Ceresan 200, Ceresan M, Ceresan M-2X

Mercurial fungicide-insecticides

Panogen 15 + Drinox

Resistance of Sorghum Varieties and Hybrids to the Chinch Bug

R. E. Painter and J. A. Sifuentes (Manhattan)

This is a report on studies made by Juan Antonio Sifuentes, a graduate student, and submitted in partial fulfillment of the Master of Science degree at Kansas State College. In this study about 50 varieties, regional hybrids and experimental hybrids and their parents were studied over a period of two years in the field. Laboratory studies were also made. The field studies were not entirely satisfactory since the first year the plants were attacked when they were too young, and in the second year difficulty was experienced because of wet weather. The chinch bug resistant variety, Atlas, was used as a resistant check and the chinch bug susceptible variety, Dwarf Yellow milo, as a susceptible check. The results with these two varieties were quite comparable with the results found by Snelling and others in the studies made in the 1930's. The average percent of plants surviving in the two years ranged from zero to 48%. Among the hybrids in the test RS 630 was the most resistant and was approximately equal to Atlas in this respect. On the other hand, Texas 660 was about as susceptible as Dwarf Yellow milo. The other hybrids studied were intermediate. Among the varieties Caprock, Plainsman and Combine-7078 were about as susceptible to chinch bugs as was Dwarf Yellow milo. The varieties Redbine-60, Redlan, Combine Kafir-60, Dwarf Kafir 44-14, and Midland were somewhat intermediate in resistance but were a distinct improvement over Dwarf Yellow milo in resistance to chinch bugs. These varieties were, however, much below Atlas in resistance.

In insectary studies female chinch bugs reared on Dwarf Yellow milo laid eggs at the rate of eight per day, on Plainsman at the rate of six per day, and on RS 650 and Combine Kafir-60 at the rate of two per day. On Atlas the rate of oviposition was 0.16 per day. Thus resistance as measured in this manner was apparently dominant in the cross of Plainsman x Combine Kafir-60.

A study was made of the amount of plant liquids taken up from resistant and susceptible varieties by individual chinch bugs. Such chinch bugs were weighed before and after feeding. It was found that approximately equal amounts of plant juices were taken from the resistant and susceptible varieties studied. The varieties studied were Atlas, Dwarf Yellow milo, RS 610, RS 650 and the parents of these two latter hybrids Combine-7078, Combine Kafir-60 and Plainsman.

Mr. Sifuentes thesis is on file at Kansas State College library.

Fertilizers for Sorghum

Floyd W. Smith (Manhattan)

Introduction

Use of fertilizers in this area is widespread in the case of both the wheat and corn crops. However, the use of fertilizers to increase the productivity of the sorghum crop is not a general practice. Part of this lack of use of fertilizer on this crop may be attributed to lack of information among farmers relative to its response to fertilizer. Another reason for less use of fertilizer on this crop is the fact that it is grown mainly in those portions of the Great Plains where the fertilizers generally are not used. There also is a lack of satisfactory equipment for application of fertilizers in some of the areas of production and under some methods of planting.

Response of Kafir to Fertilizer in the Rotation

Investigations conducted at the Thayer Kansas Experiment Field during the period, 1939-50, inclusive, indicated clearly that kafir was responsive to application of limestone, manure, and superphosphate. Application of limestone to the acid soil at Thayer gave an annual increase in yield of grain of 4.5 bushels per acre. Use of manure in addition to the limestone added another 4 bushels of kafir grain. The addition of superphosphate to both wheat and kafir in the rotation in addition to the basic limestone treatment gave an extra 8.2 bushels of kafir grain per acre. Residual benefits from application of superphosphate to wheat and/or flax ranged from 2 to 5 bushels per acre in the case of kafir grain even where no superphosphate was applied directly to this crop. These responses of kafir to applications of superphosphate are more than generally have been noted for corn produced under somewhat similar circumstances (Table 1).

Atlas Sorgo Responds to Fertilizer

Early investigations of response of Atlas sorgo to application of fertilizers were conducted in the vicinity of Manhattan, Kansas, during the growing season of 1946. This season was abnormally dry for this locality. Data collected on four farms indicated that response in yield of grain to application of fertilizer did not occur at two locations where moisture supply was the limiting factor. Increases in the yields of grain amounting to 13 and 15 bushels per acre were obtained for the other two locations. A need for only nitrogen was indicated in the case of the one field which was located on Blue River Valley land north of Manhattan while a need mainly for phosphorus was indicated at the other field which was located on upland soil west of Manhattan. Moisture relationships apparently were more favorable for these latter two locations than for the other two (Table 2).

Response of Grain Sorghum to Application of Fertilizer

A number of rather extensive grain sorghum fertilizer trials have been conducted since 1951 mainly in central Kansas. These experiments were designed so as to measure response to the individual fertilizer nutrient constituents -- N, P_2O_5 and K_2O and to measure response to various rates of applied nitrogen.

Response in yield of non-irrigated grain sorghum was of greatest magnitude in the case of the sandy land soils such as occur in Barton and Stafford Counties, Kansas. The response was excellent in each of the years 1952 and 1953 despite rather severe drought.

As may be seen in Table 3, an average yield response of about 19 bushels per acre was obtained at the Edward Voight farm near Great Bend, Kansas, for the two-year period of 1952-53. In 1954 when little summer rainfall was received, there was no yield response. In the case of trials conducted on the Sandyland Experiment Field near St. John, Kansas, as much as 26.6 bushels per acre increase was received for fertilizer during the two-year period, 1953-54 (Table 4).

It was noted in the cases of both the Voight and Sandyland Experiment Field trials, that use of nitrogen alone did not produce maximum yield increases. Complete fertilization including phosphate and potash along with 80 lb. per acre of N was required at the Voight location during 1952 and 1953 when moisture relationships were favorable. Apparently only 40 lb. per acre of N were needed at the St. John location, but both phosphate and potash seemed to be needed.

Good yield response was obtained with sorghum grown on the friable silt loam soil near Belleville, Kansas, for the three years, 1952-54, inclusive (Table 5). Average increases amounting to as much as 13 bushels of grain per acre were received. Application of 40 lb. per acre of N alone gave about five bushels increase; addition of 40 lb. per acre of available P_2O_5 to this amount of nitrogen added another four bushels.

Increasing the rate of N to 80 lb. per acre added still another three bushels to the yield of grain. Inclusion of potash in the fertilizer treatment did not increase the yield of grain appreciably. Soils in the Belleville area generally are well supplied with available potassium. Profitable yield responses on such soils can be expected only for application of nitrogen and available P_2O_5.

Response of sorghum to application of nitrogenous fertilizer is more unlikely on the hardlands of central Kansas than it is on either the Sandylands in the same area or on the open friable silt loam soils of northcentral Kansas (Table 6). Drought damage was much more serious on such soils during years such as 1952 and 1953 than on the open soils where the deeper subsoil presented a more favorable moisture relationship. At Hutchinson, for the three-year period, 1951-53, inclusive, no profitable response in yield of sorghum to application of nitrogen was noted. An average increase of about two bushels per acre was received for application of 40 lb. per acre of available P_2O_5. Results at Canton, Kansas, also were quite unfavorable. Soil at each location was fairly well supplied with organic matter and was very high in content of exchangeable potassium. Available phosphorus content at each location was only medium, however.

Claypan soils in eastern Kansas such as are found in the vicinity of Ottawa were somewhat more favorable for sorghum production during drought years than were those at either Hutchinson or Canton (Table 7). However, yield response to nitrogen was not noted during the two very dry years of 1954 and 1955. An average increase of about 11 bu. per acre was noted for use of phosphate and potash. Soils in the Ottawa area are quite low in available phosphorus content and somewhat lower in available potassium than the hardland soils of central Kansas.

<u>Response of Sorghum to Fertilizer Application in Southwest Kansas</u>

A number of fertilizer trials have been conducted upon sandyland soils of south western Kansas by the Garden City Agricultural Experiment Station personnel. Results for three trials conducted in 1954 are recorded in Table 8. It may be observed that response seemed to depend especially upon moisture supply. At the Knier location in Stevens County, Kansas, excellent yield response was noted especially for as much as 80 lb. per acre of added nitrogen and to a certain extent for addition of phosphate. This location received a good supply of moisture during the summer and also had a good supply in the soil at planting time. In the case of the James location, also in Stevens County, Kansas, the amount of summer rainfall received was not great. Inasmuch as sorghum had to depend mainly upon the stored moisture, yield response to fertilizer application was not so great. Apparently the use of only 40 lb. per acre of N was justified under these circumstances. In the case of the trial conducted in 1954 in Morton County, Kansas, where neither the amount of moisture received as summer rainfall nor the amount previously stored in the soil was as great as was true for the Knier location in Stevens County, the response to fertilizer was so small as to be unprofitable.

Similar trials were conducted again in 1955 upon the dryland soils of southwestern Kansas. As may be seen in Table 9, some yield response was obtained at both the Hedrick and Packer locations where an excellent supply of soil moisture prevailed at planting time and where a fair supply was received during the summer. Response was not as good as was noted for the Knier location in 1954, however, upon the basis of these data (Tables 8 and 9), it must be recognized that a very substantial amount of summer rainfall was needed to insure outstanding results from use of large amounts of nitrogeous fertilizer for grain sorghum, irrespective of how much subsoil moisture may be stored.

It would appear that if as much as 48 inches of subsoil moisture has been stored in a sandyland soil, that comparatively good results can be anticipated from the use of 40 lb. per acre of N on non-irrigated sorghum. Use of as much as 80 lb. per acre of N would seem to be justified only if above average amounts of summer moisture could be supplied, perhaps by supplementary irrigation. In southwestern Kansas, it appears doubtful as to whether or not favorable phosphate response can be expected upon these sandyland soils, at least under present circumstances.

Response of Irrigated Sorghum to Fertilizer Application

Sorghum fertilizer trials have been conducted under irrigation in central and eastern Kansas. Most of these trials have not shown particularly good response to application of fertilizer. However, certain trials in southwestern Kansas (Table 10) and a trial conducted in western Nebraska (Table 11) have indicated that excellent response can sometimes be obtained under irrigation. The results obtained in southwestern Kansas suggest response only for the application of nitrogen. Inclusion of phosphate did not add appreciably to the yields. The Nebraska trial (Table 11) also suggested response only to nitrogen. The Nebraska trial suggested that larger amounts of nitrogen are required in that area than are required in southwestern Kansas. The same situation has been noticed in Kansas with wheat where yield response to a given nitrogen application has been nearly twice as great in northern Kansas counties as has been true in southern Kansas counties.

Capability of Varieties or Hybrids for Producing High Yields

The genetic characteristics of the plant may be such as to make it capable of yielding very large amounts of a crop or, on the other hand, may be such as to place a definite "ceiling" upon its yield potential. For purposes of illustration the example in Table 12 is given.

Table 1. Response of kafir to fertilizer in rotation[1], Thayer, 1939-50.

Treatment	Yield	
	Grain (bu./A)	Forage (T/A)
No treatment	16.4	1.95
Lime[2]	20.9	2.38
Lime + Superphosphate[3] on wheat and flax	25.3	2.82
Lime + Superphosphate on flax	25.6	3.21
Lime + Superphosphate on wheat	23.1	2.71
Lime + Manure	24.9	2.74
Lime + Manure and Superphosphate on wheat and flax	29.7	3.10
Lime + Superphosphate on wheat and kafir	29.1	3.06
Manure[4]	22.2	2.54

1/ Rotation = flax (sweetclover), kafir, soybeans, wheat
2/ Lime = 2 T/A
3/ Superphosphate = 120 lb./A of 0-20-0
4/ Manure = 8 T/A ahead of soybeans

Table 2. Response of Atlas sorgo to fertilizer, 1946.

Treatment $N-P_2O_5-K_2O$	Yield of grain (bu./A)			
	Anderson (Randolph)	Burtis (Manhattan)	Nott (Alma)	Visser (Riley)
0-0-0	41.3	21.0	25.7	42.0
30-0-0	56.6	20.9	27.0	42.3
0-30-0	42.2	21.0	25.1	53.3
30-30-0	48.7	19.3	22.7	48.0
30-30-30	51.5	21.8	23.4	55.3

Table 3. Response of grain sorghum to fertilizer on Edward Voight farm, Great Bend.

Treatment $N-P_2O_5-K_2O$	Yield (bu./A)			
	1952	1953	1954	Average
0-0-0	42.9	48.5	30.3	40.6
40-0-0	49.5	55.2	29.4	44.7
80-0-0	47.5	59.6	28.6	45.2
0-40-0	48.3	45.4	31.1	41.6
40-40-0	56.4	65.7	26.7	49.6
80-40-0	50.8	67.8	25.9	48.2
0-40-40	52.5	49.3	23.2	41.7
40-40-40	57.7	65.8	24.2	49.2
80-40-40	60.0	69.3	28.7	52.7

Table 4. Response of grain sorghum to fertilizer at Sandyland Experiment Field, St. John, 1953-54.

Treatment $N-P_2O_5-K_2O$	Yield (bu./A) 2-yr. average
0-0-0	31.0
40-0-0	39.5
80-0-0	38.7
0-40-0	41.7
40-40-0	47.0
80-40-0	46.0
0-40-40	48.0
40-40-40	57.6
80-40-40	47.0

Table 5. Response of grain sorghum to fertilizer at Belleville, 1952-54.

Treatment $N-P_2O_5-K_2O$	Yield (bu./A) 3-yr. average
0-0-0	40.4
40-0-0	45.5
80-0-0	50.5
0-40-0	40.2
40-40-0	49.7
80-40-0	52.7
0-40-40	40.2
40-40-40	47.2
80-40-40	53.3

Table 6. Response of grain sorghum to fertilizer at various locations in Kansas.

Treatment $N-P_2O_5-K_2O$	Yield (bu./A) Hutchinson (1951-53)	Canton (1952-53)
0-0-0	31.1	16.1
40-0-0	28.5	21.9
80-0-0	--	18.4
0-40-0	35.2	18.6
40-40-0	35.0	17.4
80-40-0	--	19.5
0-40-40	36.4	20.2
40-40-40	37.2	19.2
80-40-40	36.2	20.3

Table 7. Response of grain sorghum to fertilizer at Ottawa, 1954-55.

Treatment $N-P_2O_5-K_2O$	Yield (bu./A) 2-yr. average
0-0-0	25.2
40-0-0	24.5
80-0-0	28.8
0-40-0	30.8
40-40-0	29.4
80-40-0	25.2
0-40-40	36.4
40-40-40	28.5
80-40-40	27.4

Table 8. Response of dryland grain sorghum to fertilizer in southwest Kansas, 1954 (Sandyland Soils). 1/

Treatment $N-P_2O_5-K_2O$	Yield (bu./A) S. S. Knier Stevens Co.	Harold James Stevens Co.	Bob Chambers Morton Co.
0-0-0	31.6	29.1	28.6
40-0-0	49.3	37.5	29.9
80-0-0	59.3	38.3	33.4
0-40-0	37.4	28.6	29.9
40-40-0	53.4	37.0	31.4
80-40-0	57.2	36.6	31.7
0-80-0	34.8	32.2	31.4
40-80-0	52.8	36.6	35.2
80-80-0	62.2	35.2	28.0
Precipitation (June-Oct.)	12 in.	2 in.	5.80 in.
Depth of soil moisture at planting	48 in.	48 in.	36 in.

1/ Data collected by Roy Herring, Garden City Experiment Station.

Table 9. Response of dryland grain sorghum to fertilizer in southwest Kansas, 1955 (Sandyland Soils). 1/

Treatment $N-P_2O_5-K_2O$	Yield (bu./A) Hedrick	Packer	Demuth
0-0-0	37.8	36.1	17.0
20-0-0	--	39.6	16.4
40-0-0	44.1	40.4	14.3
80-0-0	45.5	46.0	15.9
0-40-0	32.9	31.6	13.8
20-40-0	--	32.8	14.2
40-40-0	42.5	42.4	15.8
80-40-0	39.8	42.8	13.6
0-80-0	37.2	33.5	16.5
20-80-0	--	39.5	13.8
40-80-0	43.4	29.2	13.8
80-80-0	44.2	40.5	14.4
Precipitation (June-Oct.)	8.5 in.	7.0 in.	3.5 in.
Depth soil moisture at planting	66 in.	60 in.	36 in.

1/ Data collected by Roy Herring, Garden City Experiment Station.

Table 10. Response of irrigated grain sorghum to fertilizer in southwest Kansas, 1955. 1/

Treatment $N-P_2O_5-K_2O$	Yield (bu./A) Squire	Meyer	Hawk	Mayo
0-0-0	32.2	42.0	82.6	74.0
30-0-0	40.0	53.2	77.8	71.2
60-0-0	56.6	65.0	93.6	--
90-0-0	61.0	66.6	85.0	75.9
0-80-0	32.2	44.8	87.5	--
30-80-0	37.2	--	--	--
60-80-0	54.4	66.1	93.6	--
90-80-0	60.5	--	--	--

1/ Data collected by L. V. Withee, formerly of the Garden City Experiment Station.

Table 11. Response of irrigated grain sorghum to fertilizer at Furnas Co., Nebraska, 1955.

Treatment $N-P_2O_5-K_2O$	Yield (bu./A)
0-0-0	62
40-0-0	94
80-0-0	98
160-0-0	114
0-40-0	59
40-40-0	86
80-40-0	101
160-40-0	113

Table 12. The influence of sorghum varieties or hybrids and fertilizer treatment upon the yield of grain produced, Rossville, 1956.

Treatment $N-P_2O_5-K_2O$	Yield of Grain Sorghum (bu./A)				
	Martin	Plainsman	DeKalb E-56	DeKalb D-50	RS 590
0-0-0	68	70	67	70	73
150-150-150	77	78	78	82	90

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KENTUCKY

Sudan Variety Test, 1957

J. F. Shane (Lexington)

Seeded: Princeton 6/17/57
Woodford Co. 7/3/57

	Yield T.D.M./A		Disease rating 1/		
	Princeton 3 harvests	Woodford Co. 2 harvests	Princeton 7/26	Princeton 9/7	Woodford Co.
Common	3.96	1.96	7	6	7.0
Piper	3.62	1.81	3	4	5.0
Greenleaf	2.89	1.74	1	4	3.0
Sweet Common	3.04	1.55	7	5	2.5
Ga. 337	3.82	1.61	1	3	2.0
Stoneville Sel.	2.34	1.67	1	3	1.5
Lahoma	2.86	1.51	1	4	1.0
Stoneville Syn # 1	3.34	1.82	1	2	2.0
L.S.D. .05	0.73	0.26	2.1	0.9	1.1
.01	0.99	N.S.			1.4

1/ Average of four replications. 1 = least disease symptoms to 9 = most disease symptoms (primarily Helminthosposium leaf blight).

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MISSOURI

Cooperative Studies
Departments of Agricultural Chemistry and Field Crops

George B. Garner, L. E. Cavanah, and E. L. Pinnell (Columbia)

Ten varieties and four hybrids were grown in a randomized block yield trial at Columbia. Analyses for total protein and alcohol-soluble protein were made on samples from each of the four replicates.

Table 1. Yield, total protein, and alcohol-soluble protein on 14 grain sorghums grown at Columbia, Missouri, 1957.

Variety	Bu./ acre	Total protein %	Alco. sol. protein %	Variety	Bu./ acre	Total protein %	Alco. sol. protein %
Redbine	72	10.7	0.71	DeKalb E 56A	98	10.3	0.68
Martin	75	10.7	0.62	RS 590	95	10.4	0.59
Midland	79	10.3	1.06	RS 610	98	9.4	0.53
Westland	66	13.2	0.65	Tx 620	94	10.4	0.60
Plainsman	87	10.0	0.72	RS 650	97	9.7	0.43
Combine-7078	59	12.0	0.62	CK-60	75	10.2	0.65
Redbine-66	79	11.9	0.86	DK 44-14	84	9.4	0.69

It is interesting to find the alcohol-soluble portion of these sorghums to be much less than that found in corn. This suggests that a detailed study of the biological value of sorghum protein should be undertaken in correlation with the crude protein of various varieties.

Animal Husbandry Investigations

A. J. Dyer (Columbia)

We have compared silage made from sorgo with corn ensilage in rations fed to steer calves. Our tests show that sorgo silage is approximately 60% of the value of corn silage on a ton basis. To secure the same rate of gain as from corn silage 3 to 4 pounds daily of corn or its equivalent per head needs to be supplied. We have found that when sorgo is more nearly mature the feeding value is greater than when the crop is ensiled earlier.

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NEBRASKA and U.S.D.A.

O. J. Webster (Lincoln)

The sorghum breeding and testing work in Nebraska is conducted on the experimental stations located at Lincoln, North Platte, and Alliance, and also on a rented field near Hastings. These locations are in a line from the southeastern to the northwestern corners of the state and are separated by approximately 150 miles. All breeding work is directed from the main station at Lincoln. Several sorghum tests are conducted by Outstate Testing of the Department of Agronomy in areas of the state not

served by the experiment stations. The report of the 1957 tests is printed in Circular No. 67. A unique phase of this testing program was the cooperative projects with a few Vocational Education Departments in High Schools. Under this program projects were set up by the boys who kept a complete set of records of all steps from drilling plates to harvest. Greater increases in production at present can be accomplished by adopting proper cultural practices than from improved varieties, and such a cooperative program with young farmers is an excellent means of education.

The Nebraska sorghum acreage for 1957 was over two million, or about twice the 1956 acreage and five times the average for the 1946-55 period. An estimated 34 percent of the acreage was planted to hybrids, and this figure will approach 50 percent in 1958. The acreage planted to hybrids is limited by inadequate seed supplies.

At Lincoln the yields of the forage hybrids RS 301F and RS 303F were lower than those for Atlas, Axtell, and Rox. At North Platte, however, these hybrids yielded more than 18 tons (70% moisture) which was above that for Atlas and Axtell. To date, few of the forage hybrids that have been grown in yield tests or in observation plantings appear productive enough for release. Unless the hybrids RS 301F or RS 303F show some unusual quality in feeding trials, seed production will be discontinued. The Dairy Department fed a silo of RS 303F but the results are not available at this date.

A forage test was conducted to determine the optimum time for making silage, and to determine the relative yield of sterile hybrid sorgos when selfed with those permitted to cross pollinate. The two varieties, Atlas and Rox, and the two hybrids, RS 301F and RS 303F, were planted in blocks and harvested at six weekly intervals beginning at the full bloom stage. Extra plots of the hybrids were planted and the heads protected from pollination by bagging in order to compare the yields with those plots which were permitted to set seed by cross-pollination. Stalks from each plot were finely chopped and packed into one-gallon jars and sealed. The silage made in this manner will be evaluated by the Dairy Department by a system of scoring as well as by chemical analysis. The average increase in yield from blooming to maturity was 68 percent, and during this period the moisture was reduced from about 80 to 70 percent. The hybrids when permitted to set seed by cross-pollination, increased in weight from blooming to maturity by about 86 percent as compared with a 52 percent increase when they were not permitted to set seed. During this period Atlas and Rox increased in yield by 70 and 52 percent, respectively. In general, the refractometer readings increased each week from blooming to maturity. The hybrids when permitted to open-pollinate averaged 11 percent higher in yield than when seed set was prevented by bagging the heads.

Several yield tests of hybrids were conducted but one for studying combining ability was of most interest. This test included 128 hybrids derived from crossing 8 sterile lines with 16 restorers, together with

the restorers and the B lines of the steriles. The hybrids with 7078 as a restorer averaged 73 bushels. The restorers which gave higher average yields included N-35, 4610, 2965, 3309, 3336, and 2959. None of these restorers are presently used in commercial hybrids. The average yields of the hybrids with a common A line were ranked from high to low as follows: A385, A1723, A Wheatland, A3021, A1104, A Martin, A Westland, and A Midland. The Wheatland sterile is an early selection from the variety. The most significant conclusion which can be drawn from this test is that a poor or mediocre line will generally make a poor hybrid.

A few stations in the region have in the past two years attempted to study resistance to charcoal rot by the tooth pick method. At Lincoln in 1957 toothpicks, cultured with the charcoal rot organism, were inserted into the base of two plants in each of 50 rows a week after full bloom. Two more plants were inoculated in each row every week for six weeks. The plants were sectioned in early December. In general, the amount and degree of infection did not differ from the first to the last dates of inoculation. There was, however, a marked difference in the amount of stalk rotting between rows. In a normal fall when temperatures are higher, the rotting should be a cause of lodging.

From a uniformity trial it was concluded that plots 10 feet in length with perfect stands had as low a coefficient of variability as plots 4 rows by 25 feet in size.

Genetic studies are being conducted along the following lines:

1. Inheritance studies of several seedling mutants derived from irradiation with neutrons and X-rays.

2. The development of reciprocal translocations to be used as genetic testers.

3. The development of stable tetraploids.

4. The selection of variant lines derived from irradiation which are of practical value. These include variants for maturity, height, and head type. A grassy type has been found which may be of value in sudan grass breeding.

5. A study of the inheritance of a dozen mature plant characters.

6. A study of a non-dehiscent anther character found in a Gold Coast variety.

7. The development of an antherless cytoplasmic sterile line which will not shed pollen under any condition.

8. A study of the inheritance of cytoplasmic sterility and the factors for yield in sorghum hybrids.

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NORTH DAKOTA

Sorghums and Sudan in North Dakota

J. F. Carter, P. C. Sandal, and A. B. Schooler (Fargo)

Forage sorghums

Forage sorghums yielded favorably in comparison to open-pollinated corn at Fargo, Dickinson, and Edgeley, North Dakota, in tests conducted mostly in the 1930's to 1944. Acreage of forage sorghums grown has gone down from about 200,000 acres in 1930 to approximately 10,000 acres annually. The need for emergency forage developing in late spring some years has prompted a renewed testing program for sorghum as compared to hybrid yellow dent corn and open-pollinated rainbow flints. Sorghums also are seeded after late weed control; if too dry or too wet soil prevents earlier corn seeding; if corn acreage restrictions prevent the farmer from growing desired acreage of grain plus silage corn; or if hail or some other hazard destroys a seeded crop. Testing began at Fargo in 1952 and at all branch stations in 1954. Only two branch stations, Edgeley in the southeast and Dickinson in the southwest, will continue extensive sorghum testing beyond 1957.

Sorghums have produced excellent forage yields at Fargo, 1952-57. Dry matter yields of some varieties exceeded eight tons an acre in small test plots in 1957. Sorghum has equalled or excelled corn for forage production but has been slightly inferior to corn for TDN production in most years at Fargo. One or more sorghum varieties and corn grown in 2-foot spaced cultivated rows have been significantly more productive than in 3-foot cultivated rows or drilled seedings. Forage production and other data are present in Table 1. Plant size has been similar in 2-foot and 3-foot cultivated rows. Plants in drilled seedings are usually 2-3 feet shorter than row plants and may lack or produce a small inflorescence. Sorghum withstands drouth or cool wet fall periods in better forage condition than corn at Fargo and retains a more favorable moisture content for silage production through mid-September.

Sorghum and corn are much less productive at the branch stations, except under irrigation at Williston, than at Fargo. Sorghum has produced as much or more than corn at Edgeley and under irrigation at Williston but generally has been inferior or unadapted at dryland northern and western stations.

Sorghum is seeded approximately June 1 or two weeks after average corn planting time. Harvest for silage occurs about September 20 at Fargo and Edgeley but about a week earlier at northern and western stations. Early frosts cause some dehydration, but sorghum holds its forage quality after frost better than corn. Severe killing frosts do not usually occur until approximately October 1.

Table 1. Forage production and other characteristics of sorghum in drilled plots and 2-foot or 3-foot cultivated rows, Fargo, North Dakota. 1952-57.

Varieties	Tons of forage an acre at 12% moisture, 1952-57 average 2/ Drilled	2' rows	3' rows	Variety average	Height in inches 1952-57 av. Drilled	2' rows	3' rows	Seed maturity	Leaf diseases 3/
Fremont sorghum	4.86	6.12	4.62	5.20	67	84	78	heavy dough	6
Ellis sorghum	4.44	6.05	4.99	5.16	74	92	92	early milk	1
Rancher sorghum	5.58	5.97	4.96	5.50	75	86	85	hard seed	9
Leoti Red sorghum	4.95	6.21	4.97	5.38	69	92	87	milk to dough	2
Norkan sorghum	4.89	7.06	5.05	5.67	58	87	82	late milk	5
Rox Orange sorghum	5.27	5.78	5.08	5.38	63	86	85	late milk	6
Nebraska Red Amber sorghum	5.66	6.26	5.36	5.76	81	97	94	dough	7
Piper sudangrass	4.62	5.08	4.26	4.65	77	92	90	dough, hard seed	8
Sweet sudangrass	4.27	4.65	4.40	4.44	72	82	78	heavy dough	9
Mandan flint corn 1/		4.51	3.81	4.16		70	71	glazed	1
Nodak 301 corn 1/		5.02	3.93	4.97		.8	79	early dent	1
All sorghum average	5.09	6.21	5.00	5.44	70	89	86		

1/ Mandan flint and Nodak 301 whole plant yields from earlier seedings, checked corn, in the Corn Project of Mr. Wiidakas, were 4.12 and 4.09 tons of 12% moisture forage an acre for the 1952-57 period.

2/ Multiply tons at 12% moisture by 2.9 to give silage yields at 70% moisture, or Leoti Red produced 6.21 tons x 2.9= 18.0 tons of 70% moisture silage an acre in 2-foot rows at Fargo, 1952-57. One or more sorghum varieties have produced significantly or highly significantly more forage each year and all years average than corn at Fargo.

3/ Incidence of Pseudononas syringae, 1- disease free, 10-severe infection.

Rancher and Fremont usually mature hard seed in rows at Fargo while Leoti Red reaches the dough stage. Most other varieties do not get past boot to milk stage. Axtell, Sourless White, Sumac 1712, etc. have been tested and are productive but too late. Rancher, Leoti Red, and Fremont are recommended varieties.

No forage sorghum breeding program is conducted in North Dakota. Problems of forage sorghum culture are (1) the disease caused by Pseudomonas syringae except on Leoti Red and Ellis; (2) most varieties are too late especially in drilled seedings; (3) lack of timely and adequate late summer rainfall; (4) cool soils early and below optimum air and soil temperatures through most of the growing season (long days counterbalance some of low temperature effect); (5) cold nights, dry soils at seeding time, and weed competition in the north and west; (6) frequent poor performance of the following crop because sorghum has used soil moisture and nitrogen late the previous fall.

Sudangrass testing

A uniform sudangrass testing program has been conducted cooperatively with the U.S.D.A. since 1952. Piper sudan has excelled for forage production among low HCN varieties, 1952-57 (see Table 2). A variety x pasture stage cuttings significant interaction occurs annually as the southern varieties recover more slowly after cutting or grazing than Piper, Common, Wheeler, or California 23. Sudangrass is used mainly for July and August pasture in North Dakota and the use of Piper is increasing rapidly to near 40,000 to 50,000 acres in 1958. Sudan is seeded about June 1 and is ready to graze by July 1 in southeastern North Dakota. Piper sudan has averaged 1050 sheep days grazing an acre, 1954-57, in a regional project studying rate of intake and digestibility in improved forage evaluation techniques.

Seed of sudan and sorghum for seeding purposes must be imported because early frosts injure seed germination of sorghum and sudan most years.

Sudangrass improvement

The sudangrass breeding program in North Dakota was initiated in 1949 largely as a survey of a wide range of breeding stocks as source material for an improvement program. An improvement program was started on the basis of the great potential of sudangrass for summer grazing when permanent pastures are less productive. The objectives of the project are to produce, select, and test lines of sudangrass which are agronomically adapted to North Dakota conditions and which are lower in hydrocyanic acid content than the commonly grown varieties.

Emphasis has been placed on field-handling segregating and advanced-generation lines in a manner that individual plant HCN and agronomic analyses can be conducted as well as production and recovery of full

Table 2. Forage production[1] and other characteristics of sudangrass varieties, 1951-57, at Fargo, North Dakota.

Varieties, years tested	Tons of forage at 12% moisture		Hay characteristics at harvest		
	Hay	Pasture	Inches high	Diseases[2]	Maturity[3]
Piper, 1951-57	4.58	3.17	78	8	10
Greenleaf, 1953-57	4.37	2.64	73	5	6
Common, 1951-57	3.92	3.23	76	9	10
Wheeler, 1953-57	3.70	3.32	73	10	10
Sweet, 1951-57	4.36	2.74	72	6	9
Sweet 372, 1953-57	4.08	3.01	70	7	9
Sweet 372, S-1, 1953-57	4.02	2.76	70	6	9
Stoneville Syn. 1, 1957	6.81[4]	3.16	98	5	7
Stoneville Sel., 1957	6.79[4]	3.02	99	4	3
Tift, 1952-57	4.34	2.87	80	5	8
California 23, 1957	5.67	4.46	85	9	10
Georgia 337, 1953-57	4.16	2.59	74	4	6
Lahoma, 1954-57	4.39	2.49	67	6	3
LSD_{05} (1954-57 varieties only)	.71	.18			

1/ Hay stage was cut once about Sept. 20 each year; pasture stage cut 2 or 3 times annually or total of 15 cuttings, 1952-57, at 24-30 inches high. Crude protein production of Piper averaged 740 and 406 pounds an acre annually for pasture and hay stage, respectively, for 1953-57.

2/ Incidence of Pseudomonas syringae, 1-disease free, 10-severe infection.

3/ Maturity: 1-preboot, 2-boot, 3-anthesis, 5-milk, 8-dough, and 10-hard mature seed. Common and Wheeler occasionally showed panicles at 30 inch height of pasture stage in late summer, but were none on any other variety.

4/ Piper, Greenleaf, and Georgia 337 also produced over six tons of hay in 1957.

stands under pasture- and hay-stage harvesting. Special attention also has been given to selection for disease resistance, especially leaf spot caused by Pseudomonas syringae. Leaf spot is quite severe on all commercial varieties available. Correlation studies are being made among various agronomic estimates (notes) and measurable attributes in an effort to develop index-techniques that may be useful in a selection program.

Progress has been shown in isolating lines considerably lower in HCN and freer from leaf spot disease than the average of check varieties with desirable yield and adaptability. Several of the better advanced generation lines are being increased for further evaluation as potential improved varieties.

Grain sorghum breeding

A project to develop earlier strains of grain sorghums has just begun at Fargo. Some valuable early strains have been supplied by personnel at the Northern Great Plains Field Station, Mandan.

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TEXAS

The Dwarfing Genes in Kaoliang

J. R. Quinby (Chillicothe) and R. E. Karper (Lubbock)

Four genes that reduce internode elongation are known in sorghum. The genes that cause dwarfness in kaoliang were not studied until recently but have now been identified. Manchu Brown is recessive for dw_4 and is in the same height class as Tall White Sooner milo, Spur feterita, Shallu, and Sumac. Shantung Brown is recessive for dw_3 and dw_4 and is in the same height class as Texas Blackhull kafir and Kalo. It begins to appear that four genes and a modifying complex may account for all the dwarfness in sorghum that results only in a shortening of the internodes.

Inheritance of Maturity in Milo

J. R. Quinby and R. E. Karper

In 1945, three genes were reported to be responsible for the maturities found in milo. Subsequently, an earlier maturity was found in California and the variety distributed as Ryer milo. The inheritance of the genes that influence time of floral initiation have again been studied. It was found that Ryer maturity is caused by a fourth recessive gene which is closely linked with the pericarp color gene Yy that is in

turn closely linked with maturity gene, Ma_3 ma_3. Ryer milo was not subjected to 10 hour days, but it is presumed that Ryer, like all other milos, is sensitive to photoperiod. Also, the fourth maturity gene is presumed, like the other three genes, to influence response to photoperiod.

The phenotypes of the genotypes recessive for ma_4, with the exception of Ryer itself, appear to be much like Ryer. Like recessive ma_1, homozygous recessive ma_4 causes early maturity regardless of the dominant or recessive condition of the other 3 genes. Unlike heterozygous Ma_1 ma_1, however, heterozygous Ma_4 ma_4 is not later in maturity than the homozygous dominant. Actually, the data seem to indicate that heterozygous Ma_4 ma_4 plants are as early or earlier than dominant Ma_4 Ma_4 plants.

It seems impractical to assign names such as early, late, ultralate, etc. to a series of 16 maturities. It seems more practical to assign numbers as names and to use the average number of days to bloom of each genotype as it usually performs at Chillicothe. All of the maturity genotypes did not appear in the F_2 populations because none of the parents used are genetically (Ma_3 y ma_4). With the parents used, (Ma_3 y ma_4) plants in the F_3 populations would be due to crossovers.

The following names have been applied to the homozygous genotypes that appeared among the F_2 plants of the 5 populations involving Ryer that were grown in 1956.

Genotype	Days to bloom	Parents used
Ma_1 Ma_2 (Ma_3 y Ma_4)	100	
Ma_1 Ma_2 (Ma_3 y ma_4)*		
Ma_1 Ma_2 (ma_3 Y Ma_4)	90	
Ma_1 ma_2 (Ma_3 y Ma_4)	80	
ma_1 Ma_2 (Ma_3 y Ma_4)	50	White Sooner, SA 5155-5
Ma_1 Ma_2 (ma_3 Y ma_4)	44	
Ma_1 ma_2 (ma_3 Y Ma_4)	66	Yellow milo, SA 292
ma_1 ma_2 (Ma_3 y Ma_4)	50	SA 1716-1, White Sooner
ma_1 Ma_2 (Ma_3 y ma_4)*		
Ma_1 ma_2 (Ma_3 y ma_4)*		
ma_1 Ma_2 (ma_3 Y Ma_4)	50	SA 5155-36, Yellow Sooner
Ma_1 ma_2 (ma_3 Y ma_4)	44	SA 7680, Ryer
ma_1 Ma_2 (ma_3 Y ma_4)	44	
ma_1 ma_2 (Ma_3 y ma_4)*		
ma_1 ma_2 (ma_3 Y Ma_4)	50	SA 5155-23, Yellow Sooner
ma_1 ma_2 (ma_3 Y ma_4)	38	

* Crossover (not obtained)

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U.S.D.A.

Microscopic Characteristics of Starches in the Identification of Ground Cereal Grains (abstract)

M. M. MacMasters, M. J. Wolf, and H. L. Seckinger (Peoria, Ill.)

Observations made during various projects on starch and cereal grain characteristics are given to aid feed microscopists in the identification and quantitative estimation of cereal grain constituents in feeds. The microscopic appearance of ungelatinized and gelatinized starch granules can be used to distinguish the presence of most of the cereal grains. Microscopic structure of kernel parts can provide final distinction between grains that have similar starches, such as corn and sorghum.

Carotenoid Content of the Grain from Yellow Endosperm-type Sorghums (abstract)

C. W. Blessin, C. H. Van Etten and Richard Wiebe (Peoria, Ill.)

Methods for estimating total carotenes and total xanthophylls and for isolating and identifying the major carotenoids were adapted for use on grain sorghum. The grain of common varieties of sorghum contained about 1.5 p.p.m. of total carotenoids. Crosses obtained in preliminary plant breeding of common varieties with "African yellow endosperm" varieties contained carotenoids as high as 8 to 9 p.p.m. Carotenoid content was higher when the seeds were protected from the weather after pollination. Major carotenoids present were identified as lutein, zeaxanthin, and B-carotene. Other carotenoids present in small amounts in both feed sorghum and yellow corn, which were used for comparison purposes, were described but not positively identified. Carotenoids found in yellow corn but not detected in the grain sorghum were cryptoxanthin, hydroxy-a-carotene, and a-carotene.

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III. PUBLICATIONS

Anderson, R. A. Experimental wet milling of grain sorghum grits. Trans. Amer. Assoc. Cer. Chem. 13:241-248. 1955.

Anderson, R. E. et al. Performance of grain sorghum hybrids and varieties in Nebraska in 1956. Nebr. Agr. Expt. Sta. Outstate Testing Circ. 59. 1956.

Anon. Sorghum hybrids. ARS 22-26. Agr. Res. Serv., U.S.D.A. 1956.

Blessin, C. W. et al. Carotenoid content of the grain from yellow-endosperm type sorghum (in press-Cereal Chem.).

Burger, A. W. et al. Yield of sudangrass varieties as affected by time and frequency of cutting. Agron. Jour. 50:37-39. 1958.

Burleson, C. A. et al. Effect of nitrogen fertilization on yield and protein of grain sorghum in the lower Rio Grande Valley of Texas. Agron. Jour. 48:524-525. 1956.

Carter, J. F. Sudangrass for North Dakota. N. D. Bimon. Bul. 16:163-168. 1954.

Carter, J. F. Forage sorghums for North Dakota. (in press-N. D. Bimon. Bul.).

Carter, J. F. and Lars Jensen. Sudangrass for summer pasture. N. D. Agr. Ext. Circ. A-207 (rev.). 1958.

Cartier, Jean Jacques and Reginald H. Painter. Differential reactions of two biotypes of the corn leaf aphid to resistant and susceptible varieties, hybrids, and selections of sorghums. Jour. Econ. Ent. 49:498-508. 1956.

Chaffin, Wesley. Sorghums for grain and forage. Okla. Agr. Ext. Circ. 478. 1955.

Clapp, A. L. 1957 Kansas grain sorghum performance tests. Kans. Agr. Expt. Sta. Bul. 398. 1958.

Clegg, M. D. et al. Performance of grain sorghum hybrids and varieties in Nebraska in 1957. Nebr. Agr. Expt. Sta. Outstate Testing Circ. 67. 1958.

Coleman, Otto H. The occurrence and description of a dry segregate in honey sorgo. Agron. Jour. 48:475-477. 1956.

Coleman, O. H. and I. E. Stokes. The inheritance of resistance to red rot in sorghum. Agron. Jour. 46:61-63. 1954.

Coleman, Otto H. and I. E. Stokes. The inheritance of weak stalk in sorgo. Agron. Jour. 50:120-121. 1958.

Coleman, O. H. et al. Wiley, a new variety of sorgo for sirup production in Mississippi. Miss. Agr. Expt. Sta. Info. Sheet 544. 1956.

Craigmiles, J. P. et al. Sudangrass and millet variety tests. Ga. Agr. Expt. Sta. Mimeo. Series N. S. 46. 1958.

Craigmiles, J. P. et al. Quality evaluation of sudangrass and millet forage. Ga. Agr. Expt. Sta. Mimeo. Series N. S. 48. 1958.

Craigmiles, J. P. et al. The influence of method of seeding and seed treatment on stands and yields of sudangrass and millet. Ga. Agr. Expt. Sta. Mimeo. Series N. S. 47. 1958.

Craigmiles, J. P. and J. M. Elrod. Browntop millet in Georgia. Ga. Agr. Expt. Sta. Leaflet 14. 1957.

Dahms, R. G. et al. Methods of treating sorghum selfing bags for insect control. Jour. Econ. Ent. 48:568-572. 1955.

Davies, Frank E. Performance of sorghum hybrids and varieties, 1957. Okla. Agr. Expt. Sta. Mimeo. Circ. M-294. 1958.

Deatherage, W. L. et al. A partial survey of amylose content in starch from domestic and foreign varieties of corn, wheat, and sorghum and from some other starch-bearing plants. Trans. Amer. Assoc. Cereal Chem. 13:31-42. 1955.

Denman, C. E. Lahoma sweet sudangrass. Okla. Agr. Expt. Sta. Bul. B452. 1955.

Duara, B. N. and G. L. Stebbins, Jr. A polyhaploid obtained from a hybrid derivative of _Sorghum halepense_ x S. _vulgare_ var. _sudanense_. Gen. 37:369-374. 1952.

Endrizzi, John E. Cytological studies of some species and hybrids in the Eu-sorghums. Bot. Gaz. 119:1-10. 1957.

Endrizzi, J. E. and D. T. Morgan, Jr. Chromosomal interchanges and evidence for duplication. Jour. Hered. 46:201-208. 1955.

Foster, A. E. et al. Genetic analyses of F_2 populations from crosses involving colchicine-induced mutations in sorghum. (abstract) Proc. S. D. Acad. Sci. 34:21-22. 1955.

Franzke, C. J. and J. G. Ross. Colchicine-the latest tool for plant breeders. S. D. Farm and Home Res. 6:18-23. 1954.

Franzke, C. J. and J. G. Ross. A lineal series of mutants induced by colchicine treatment. Jour. Hered. 48:47-50. 1957.

Garber, E. D. Cytotaxonomic studies in the genus Sorghum. III. The polyploid species of the subgenera Para-sorghum and Stiposorghum. Bot. Gaz. 115:336-342. 1954.

Garber, E. D. Cytogenetics of sorghum I. The orientation of interchange complexes and quadrivalents at metaphase I in S. purpureo-sericeum. Bot. Gaz. 116:369-372. 1955.

George, Donald W. and Charles C. Ellwood. Sorghums in Arizona. Ariz. Agr. Ext. Circ. 218. 1954.

Goodsell, Samuel F. Germination of dormant sorghum seed. Agron. Jour. 49:387-389. 1957.

Hadley, Henry H. An analysis of variation in height in sorghum. Agron. Jour. 49:144-147. 1957.

Hadley, Henry H. Cytological relationships between Sorghum vulgare and S. halepense. Agron. Jour. 45:139-143. 1953.

Hadley, Henry H. and J. L. Mahan. The cytogenetic behavior of the progeny from a backcross (Sorghum vulgare x S. halepense x S. vulgare) 48:102-106. 1956.

Hansing, E. D. and Claude L. King. Fungicide and fungicide-insecticide treatment for sorghum seed. Bot. and Plant Path. Circ. 13. Kans. Agr. Expt. Sta. 1957.

Harpstead, D. D. et al. The nature of chromatin changes of colchicine-induced variants in sorghum. Jour. Hered. 45:255-258. 1954.

Harris, H. B. A new instrument for emasculating sorghum. Agron. Jour. 47:236-237. 1955.

Harris, H. B. and E. S. Luttrell. Grain sorghum seed treatment tests and diseases in Georgia for 1954. Pl. Dis. Rptr. 39:329-331. 1955.

Harris, H. B. et al. Growing grain sorghum in Georgia. Ga. Agr. Expt. Sta. Mimeo. Series N. S. 50. 1958.

Harvey, P. et al. Grain sorghum (milo) production in North Carolina. N. C. Agr. Expt. Sta. Circ. 382. 1954.

Hein, M. A. Sudangrass. U.S.D.A. Farmers' Bul. 1126 (rev.). 1957.

Hittle, C. N. et al. Grain sorghums in Illinois. Ill. Agr. Expt. Sta. Circ. 774. 1957.

Howitt, A. J. and Reginald H. Painter. Field and greenhouse studies regarding the sources and nature of sorghum(Sorghum vulgare Pers.) resistance to the corn leaf aphid, Rhopalosiphum maidis (Fitch). Kans. Agr. Expt. Sta. Bul. 82. 1956.

Hubbard, J. E. et al. Composition of the component parts of the sorghum kernel. Cereal Chem. 27:415-420. 1950.

Johnson, B. J. et al. The effect of five chemical compounds applied as bird repellents on grain sorghum (in press-Agron. Jour.).

Jones, Luther G. et al. Sudangrass for hay, pasture, seed. Cal. Agr. Expt. Sta. and Ext. Circ. 462. 1958.

Jones, Melvin D. and J. B. Sieglinger. Effect of the waxy gene on grain yields of sorghum. Okla. Agr. Expt. Sta. Tech. Bul. T-44. 1952.

Kalton, R. R. et al. Grain sorghum-a coming crop in Iowa ?? Iowa Farm Sci. 10:11-14. 1956.

Karper, R. E. Registration of sorghum varieties VII. Agron. Jour. 46:526. 1954.

Karper, R. E. Registration of sorghum varieties, VIII. Agron. Jour. 47:540. 1955.

Kaukis, Karl and L. P. Reitz. Ontogeny of the sorghum inflorescence as revealed by seedling mutants. Amer. Jour. Bot. 42:660-663. 1955.

Kaukis, Karl and O. J. Webster. Effects of thermal neutrons on dormant seeds of Sorghum vulgare Per. Agron. Jour. 48:401-406. 1956.

Kidd, H. J. Haploid and triploid Sorghum. Jour. Hered. 43:204, 225. 1952.

Leonard, Warren H. et al. Sorghum varieties for Colorado. Colo. Agr. Expt. Sta. Bul. 494-S. 1956.

Leukel, R. W. Treat Seed Grain. U.S.D.A. Misc. Publ. 219. 1957.

Leukel, R. W. et al. Sorghum seed-treatment tests in 1955. Pl. Dis. Rpt. 40:138-140. 1956.

Leukel, R. W. et al. Seed-treatment tests on sorghum in 1956. Pl. Dis. Rpt. 40:1071-1072. 1956.

Leukel, R. W. and O. J. Webster. Sorghum-seed treatment tests in 1957. Pl. Dis. Rpt. 41:992-993. 1957.

Loeffel, Wm. J. Grain sorghums as feeds for beef cattle and hogs. Nebr. Agr. Expt. Sta. Bul. SB439. 1957.

Lyons, E. S. Effect of plant spacings and fertilizers on the yield of sorgo. ARS 34-2. Agr. Res. Serv., U.S.D.A., 1957.

MacMasters, M. M., et al. Microscopic characters of starches in the identification of ground cereal grains. Agr. and Food Chem. 5:455-458. 1957.

Martin, John H. Broomcorn-the frontiersman's cash crop. Econ. Bot. 7:163-181. 1953.

Nelson, C. E. Grain sorghum production under irrigation in the Yakima Valley and Columbia Basin. Wash. Agr. Expt. Sta. Circ. 147. 1951.

Nelson, C. E. Effects of spacing and nitrogen applications on yield of grain sorghums under irrigation. Agron. Jour. 44:303-305. 1952.

Nelson, C. E. Hydrocyanic acid content of certain sorghums under irrigation as affected by nitrogen fertilizer and soil moisture stress. Agron. Jour. 45:615-617. 1953.

Peo, E. R. and D. B. Hudson. Comparison of corn and certain grain sorghum varieties for growing-finishing swine. 22nd Annual Rooters Day Rpt., Dept. of An. Husb., Nebr. Agr. Expt. Sta. 1957.

Peo, E. R. and D. B. Hudson. Ratios of corn and grain sorghum for growing-finishing swine. 22nd Annual Rooters Day Rpt., Dept. of An. Husb., Nebr. Agr. Expt. Sta. 1957.

Phillips, W. M. Weed control in sorghum. Kans. Agr. Expt. Sta. Circ. 360. 1958.

Pickett, Robert C. Sudangrass in Kansas. Kans. Agr. Expt. Sta. Circ. 311. 1954.

Price, Mary Emma and W. M. Ross. The occurrence of trisomics and other aneuploids in a cross of diploid x triploid <u>Sorghum vulgare</u>. Agron. Jour. 47:591-592. 1955.

Price, Mary Emma and W. M. Ross. Cytological study of triploid x diploid cross of <u>Sorghum vulgare</u> Pers. Agron. Jour. 49:237-240. 1957.

Quinby, J. R. et al. Sorghum production in Texas (in press - Tex. Agr. Expt. Sta. Bul.).

Rincker, C. M. Sorghums and millets for Wyoming. Wyo. Agr. Expt. Sta. Bul. 351. 1957.

Robinson, R. G. Grain sorghum for Minnesota? Minn. Farm and Home Sci. 13:15, 17, 19. 1956.

Robinson, R. G. et al. Shall I grow hybrid grain sorghum? Minn. Farm and Home Sci. 15:8-9. 1958.

Roney, J. N. and Ivan J. Shields. Grain sorghum insects and diseases. Ariz. Agr. Ext. Circ. 225. 1955.

Ross, J. G. Studies on colchicine-induced variants in sorghum. Agron. Jour. 46:10-15. 1954.

Ross, W. M. Stigma receptivity in cytoplasmic male-sterile sorghum. Agron. Jour. 49:219-220. 1957.

Ross, W. M. A comparison of grain sorghum varieties in plots with and without border rows (in press-Agron. Jour.).

Ross, W. M. and H. H. Laude. Growing sorghums in Kansas. Kans. Agr. Expt. Sta. Circ. 319. 1955.

Sanders, E. H. Developmental morphology of the kernel in grain sorghum. Cereal Chem. 32:12-25. 1955.

Sieglinger, John B. An aid in observing yellow endosperm in sorghum grain. Agron. Jour. 49:58. 1957.

Smeltzer, Dale G., et al. Hybrid grain sorghum trials. Cal. Agr. 12:3. 1958.

Stokes, I. E. Culture of sorgo for sirup production. U.S.D.A. Farmers' Bul. 2100. 1957.

Stokes, I. E. et al. Tracy-a new mid-season variety of sorgo for sirup production in Mississippi. Miss. Agr. Expt. Sta. Info. Sheet 483. 1953.

Swanson, A. F. Broomcorn culture in Peru. ICA-PCEA Special Reports No. 6. Lima, Peru. Feb. 1956.

Swanson, A. F. Possibilities of sorghum production in Peru. ICA-PCEA Special Reports No. 8. Lima, Peru. April 1956.

Swanson, Norris P. and E. L. Thaxton. Requirements for grain sorghum irrigation on the High Plains. Tex. Agr. Expt. Sta. Bul. 846. 1957.

Thurman, R. L. A laboratory method for determining digestible nutrients. Agron. Jour. 50:77-78. 1958.

Thurman, R. L. and R. D. Staten. Sorghum yield experiments, 1950-1954. Ark. Agr. Expt. Sta. Report Series 46. 1955.

Thurman, R. L. and E. J. Wehunt. A laboratory method for determining digestible nutrients. Agron. Jour. 47:302-303. 1955.

Walter, E. V. The sorghum midge. U.S.D.A. Farmers' Bul. 1566 (rev.) 1953.

Watson, S. A. and Y. A. Hirata. The wet milling properties of grain sorghums. Agron. Jour. 47:11-15. 1955.

Watson, S. A. and Y. A. Hirata. A method for evaluating the wet millability of steeped corn and grain sorghum. Cereal Chem. 31:423-432. 1954.

Watson, S. A. et al. Peripheral cells of the endosperms of grain sorghum and corn and their influence on starch purification. Cereal Chem. 32:165-182. 1955.

Webster, James and Frank Davies. The composition of sorghum forages at various stages of maturity and effects of weathering. Okla. Agr. Expt. Sta. Bul. B-484. 1956.

Webster, James E. et al. The chemical composition of sorghum roots and its relation to chinch bug injury. Okla. Agr. Expt. Sta. Tech. Bul. T-49. 1954.

Webster, James E. et al. Yield and composition of sorghum juice in relation to time of harvest in Oklahoma. Agron. Jour. 46:157-160. 1954.

Webster, O. J. and J. D. Furrer. Sorghums in Nebraska. Nebr. Agr. Ext. Circ. 199. 1954.

Webster, O. J. et al. Performance of grain sorghum and millet varieties in Nebraska 1955. Nebr. Agr. Expt. Sta. Circ. 49. 1955.

Woodle, H. A. Grain Sorghums. Clemson Coll. Ext. Circ. 285. 1955.

Hadley, Henry H. Chromosome numbers, fertility and rhizome expression of hybrids between grain sorghums and Johnsongrass. Agron. Jour. 50:278-282. 1958.

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